Operational Effects of Wildland Fire on Cultural Resources

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2012

A great variety of fire management actions are undertaken during the course of planned and unplanned ignitions. These can result in physical, visual, auditory and ethereal impacts to natural and cultural resources. Some of the most common fire management operations likely to impact cultural resources are described below.

Control Lines

All wildland fires, whether planned or unplanned, are managed within boundaries. Prescribed fires, for example, are required to have clearly defined geographic project boundaries to delineate where fire will be ignited and allowed to burn. Boundaries on wildfires may be highly conceptual (e.g., Planning Areas in WFDSS), geographically-specific, or something in between. As noted, the recent reinterpretation of federal wildland fire policy has provided a tremendous amount of latitude with respect to the range of potential management responses towildfires. These can be usefully grouped into three broad strategies:

1. **Full suppression/perimeter control:** Enacting tactics that achieve control of a fire and prevent it from exceeding a defined perimeter.
2. **Point or zone protection/limited perimeter control:** A variety of suppression actions are taken to protect specific points or areas from fire, usually by directing the fire movement away from or around these locations. As the name suggests, this strategy does not result in a continuous control line around the fire.
3. **Monitor/confine/contain:** Monitoring involves periodically checking the fire to ensure it continues to meet objectives, and where no further action is necessary. Confine/contain includes monitoring as well as varying types and intensities of operational actions to delay, direct or halt fire spread.

Stopping, delaying, or directing fire spread at specific locations on a landscape demands the presence of an obstacle or obstacles that will accomplish those aims. Obstacles intended to stop fire spread are called control lines. All prescribed fires must be encompassed by control lines, whereas wildfire perimeters are reflections of the strategic objectives described above (i.e., full to no perimeter control).

In some cases control lines are marked by existing natural or human-built features such as roads, water bodies, or landforms that contain little or no fuels. These features alone might be sufficient to stop or delay fire spread or, in some cases, may be "improved" by removing or altering adjacent fuels (Figure 1).

In other cases, firefighters must construct physical features—called firelines and scratchlines—on landscapes to create breaks in fuel continuity. Firelines are control lines that are scraped or dug down to mineral soils (those soils below the predominantly organic horizons that contain little or no combustible materials and, therefore, will check fire spread). In arid regions, such as the Mojave and Colorado deserts, mineral soils are often on the ground surface or very shallowly buried, thereby requiring little or no disturbance to expose (Figure 2). In wetter areas like the Pacific Islands and Pacific Northwest, by contrast, mineral soils may be deeply buried, and fireline construction involves significant movement of materials.

Scratchlines are unfinished firelines established or constructed as an emergency or temporary measure to check the spread of wildfires. For example, surface fuels may be removed to slow fire spread, but no effort is made to scrape the cleared area to mineral soil.

Appropriate fireline specifications are guided by two principles: (1) construct firelines no wider than necessary to stop fire spread, and (2) the hotter and/or faster a fire burns (which is a function of fuels, slope, weather and other variables), the wider the fireline must be. It is important to note that the construction of a fireline is frequently accompanied by fuels modification on one or both sides of that line as a means of increasing control capacity (Figure 3). For example, circumstances may call for a two foot-wide scrape (the fireline) along with a twenty foot saw cut where receptive ground fuels are flush-cut and low hanging branches on adjacent trees are removed.

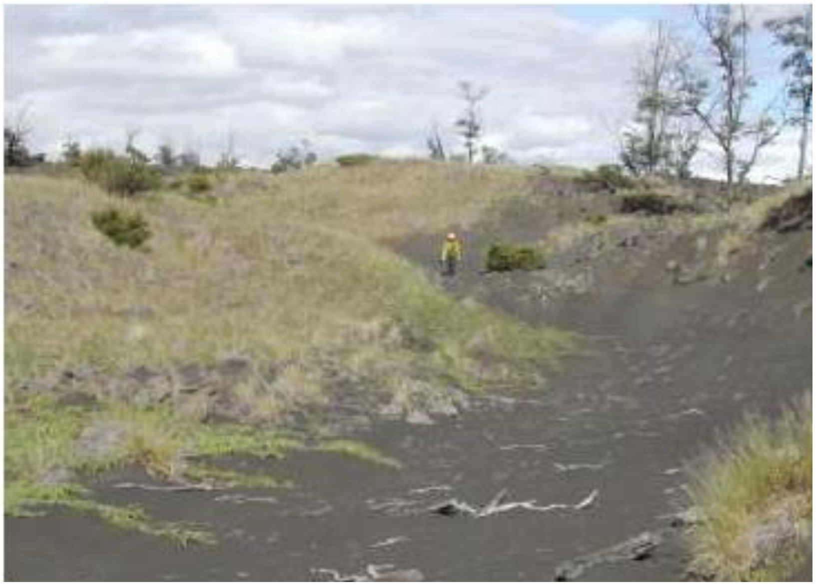

Figure 1. A natural barrier to fire spread: Cinder field (Hawaii Volcanoes NP).

Figure 2. Mineral soils (Southern Nevada Complex, NV)

Figure 3. Fireline with fuels modification.

As a general rule, the width of the modified area (scrape and clearing) will be one and a half times as wide as the dominant fuel is tall in grass and brush, and not less than one-half the height of the dominant fuel in timber. Thus, if a fire is burning in grass one to two feet tall, a scrape of one and a half to three feet may be sufficient to control the fire. In heavy brush and timber, a scrape width of five feet or more along with extensive clearing may be required (Figure 4). Further, any hazard trees, such as standing snags, located in close proximity to firelines are likely to be dropped for safety reasons.

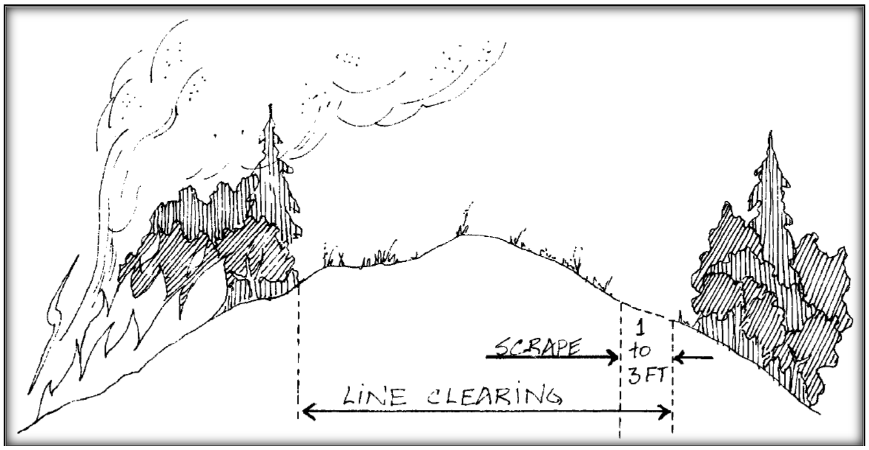

Figure 4. Line clearing dimensions are a function of fire and fuel characteristics.

A variety of methods are utilized to construct firelines. Handlines—firelines constructed with hand tools—are often employed under such conditions as rugged terrain, lighter fuels, low to moderate fire behavior, few values-at-risk and environmentally sensitive areas such as designated Wilderness. Handline construction is commonly performed with various digging and grubbing tools (Figure 5). While handlines are generally considered a relatively low impact form of fireline construction, typical production rates can be quite low, particularly in heavy fuels. For example, a five person engine crew can construct around 40 chains/hour (chain=66 feet) of handline in grass, but only around 20 chains/hour in light to medium logging slash. In cases where considerable lengths of handline must be constructed and held, large numbers of crews and other personnel may be required, along with the associated logistical support (e.g., food, water, supplies).

Figure 5. Constructing handlines.

When active fire behavior or high values-at-risk dictate rapid fireline construction, mechanized equipment may be employed. Bulldozers are a common piece of equipment on wildfires. Dozers are categorized by size (Type 1 through 3), and light (Type 3) and medium-sized (Type 2) see the greatest use on the fireline. The footprint of dozer impact is dictated largely by the width of the blade, which can vary from 7 to 15 feet. Depending on fuels and fire behavior, dozer-constructed firelines can vary from one to multiple blades in width (Figure 6), and dozers may also be used to widen or improve the holding capacity of existing roads or trails. During initial attack, a given wildfire may have only a single dozer in operation, whereas multiple dozers organized into strike teams are commonly employed on larger incidents.

From the perspective of the fire manager, one of the greatest benefits of dozers is the rapidity with which fireline can be constructed. In comparison to the handline production rate example from above, a Type 2 dozer constructing fireline uphill on a 0-25% slope in grass can complete 85-125 chains/hour in a single pass (verses 40 chains/hour), and between 30-35 chains/hour (verses 20 chains/hour) in light to medium logging slash under the same conditions. The advantages conferred by higher production rates for dozers are lost, however, on very steep slopes (>75%), heavy fuels and rocky or otherwise impassible terrain. Furthermore, in heavier fuels and active fire behavior, dozer-constructed firelines are effective only if finished and held by crews with hand tools, access to water, and/or air support.

While not particularly common, linear explosives are sometimes used to construct firelines. Depending on the nature of the fuels, fireline quality ranges from finished (in grass and light brush) to one which requires additional modification (in heavy fuels and slash). Among the advantages of explosives include production rates that exceed those of firelines constructed with hand tools and mechanized equipment (particularly in heavy fuels), smaller numbers of personnel to implement (compared to hand crews), scattering of cut fuels rather than accumulation next to the fireline, and loosening of mineral soils for subsequent digging. For these reasons, firelines created with explosives are often perceived to be more environmentally sound than other methods. On the downside, fireline explosives are complicated to execute, and require specialized logistical support.

In some circumstances, effective control lines are established without ground disturbance. For example, hand-held flappers can be effective at extinguishing fire in light fuels (Figure 7). Water and chemical derivatives—collectively referred to as fire retardants—can sometimes be used to extinguish fire or prevent its spread through the creation of "wet lines." Fire retardants are often delivered through backpack sprayers, hoses (fed by portable pumps and engines (Figure 8), and by aircraft (helicopters and fire bombers). Generally speaking, in the absence of supplemental fireline construction or other fuel alterations, wet lines will only be effective in lighter fuels such as grasses and low shrubs (Figure 9). The role of fire retardants in fire management operations is described in greater detail below.

Figure 6. Dozer constructed firelines

In cases where control lines are constructed, regardless of the tool or tools employed, a decision must be made with respect to the placement of those lines relative to the location of the fire. Direct control lines are those constructed along the leading edge of the fire that directly extinguish the flames (e.g., applying fire retardant) and/or physically separating burning and unburned fuels (e.g., constructing fireline) (Figure 10). Among the potential advantages of direct attack include minimizing acreage burned and time to containment. However, following the burning edge of the fire can also result in non-optimal control line placement (see below) and long and irregular control lines that may be difficult to hold. Further, direct attack using handline is only practicable in situations where flame lengths are less than four feet, while eight foot flames are the limit for direct attack with mechanized equipment and retardant drops.

In cases of fast-spreading or high intensity fire, indirect attack is a commonly used suppression method. In contrast to direct attack, control lines in indirect attack are located a considerable distance from the active edges of the fire (Figure 11). Depending on fuels and fire behavior, the approaching line may be allowed to burn up to the control lines or backfiring or burning out—setting fire inside a control line to consume fuel between it and the edge of the fire—is employed (Figure 12). Backfires are ignited using a variety of machine-mounted (e.g., helitorch, flame thrower) and hand-held equipment (e.g., fusee, drip torch) (Figure 13) using an array of patterns depending on the desired fire spread, behavior and intensity.

One of the greatest advantages of indirect attack is the ability to construct control lines on favorable topography. Fire behavior is strongly influenced by topography and, as such, certain landforms are better (and safer) for controlling fire than others. Ridgelines, for example, are optimum locations (Figure 14). Canyon bottoms can be used, but control lines are best placed on the side of the canyon opposite the fire to prevent burning materials from rolling across. Sideslopes and box canyons and chutes are typically

Figure 7. Fire fighter with hand-held flapper.
(NPS photo by Barb Stewart)

Figure 8. Pump on back of truck.
(NPS photo by Bill Spinrad)

Figure 9. Wet Lines will only be effective in light fuels.
(NPS photo by Scott Johnson)

Figure 10. Applying fire retardant from a backpack along a direct control line.
(NPS photo by Barb Stewart)

Figure 11. Control line in indirect attack located away from the active edges of the wildfire.

Figure 12. Burnout operations – backfire.
(NPS photo from Scott Johnson)

Figure 13. Backfire ignited with a drip torch.

Figure 14. Ridgelines are optimal locations for situating fire control lines.

poor places for control lines. Generally speaking, the more varied the topography and/or extreme the fire behavior, the more critical the placement of control lines becomes.

Among the other benefits of indirect attack include the opportunity to more easily incorporate natural and constructed features into control lines (Figure 15), control lines with fewer undulations (by virtue of not following the burning edge of the fire), and the ability to construct control lines in lighter fuels. A potential disadvantage of indirect attack is that more area is allowed to burn.

Escape Routes and Safety Zones

Escape routes and safety zones are two critical considerations for personnel on and near wildland fires. Escape routes are pre-planned routes that firefighters are directed to take away from a fire into a safety zone or other lower risk area. Escape routes may conform to obvious physical features (e.g., roads, trails, constructed control lines) or more general routes such as safe paths into previously burned areas (often called "the black").

Safety zones are areas clear of flammable materials that are used for escape in the event the control line becomes unsafe due to increased fire behavior, escape or other factor. Safety zones could be the black, existing natural or constructed features (e.g., rocky areas, water bodies, paved areas) or are constructed in the course of managing the unplanned ignition; whether existing or constructed, safety zones must be located close enough to control lines to allow rapid access by personnel. To be considered an adequate safety zone, the separation distance between firefighters and the flames should be at least four times the maximum continuous flame height. For example, a flame height of 10 feet requires a separation distance of 40 feet, and the safety zone must cover at least 1/10 acre. Under extreme conditions, such as those that occur in wind-driven southern California chaparral fires, safety zones are constructed at regular intervals by bulldozers during the course of line construction and may cover 50 acres or more (Figure 16).

Figure 15. Indirect attack incorporating an open meadow into the control line.
(NPS photo by Nate Williamson)

Figure 16. Safety zone in a dozer line.

Figure 17. Air tanker.

Fire Retardants
As noted, fire retardants are frequently used during the course of managing wildland fires. Common examples include water, long-term retardants, foams, and water enhancers.

Water is important for both fire extinguishment and pre-wetting fuels to prevent ignition. It is often delivered through a high-pressure stream or spray, or through the air as a point drop or linear stripe. Helicopters and fixed-wing aircraft that aerially apply fire retardants are, like dozers, typed by size. Airtankers—Types 1 through 4—vary in regard to retardant load carrying capacity; Type 4 (also known as single engine airtankers or SEATs) hold less than 800 gallons, while Type 1 tankers deliver 3,000 or more gallons (Figure 17). Helicopters are similarly typed by size (1 through 3); a Type 1 ship can deliver 700-plus gallons of water or retardant, compared to 100 gallons for a Type 3 helicopter (Figure 18).

Water used in wildland fire management operations may come from a variety of sources, ranging from treated municipal to the ocean. Easily accessible water in close proximity to a fire is a highly valued commodity. In places where surface water sources are few and far between, such as the Colorado and Mojave deserts, fire managers may establish temporary water-holding devices (Figure 19). Even where natural sources are relatively abundant, considerable efforts may be taken to extract and distribute water as needed (Figure 20). The presence of aircraft with water holding capabilities, and small helicopters in particular, can greatly expand water procurement capabilities on an incident, and water from multiple sources with greatly varied uses, histories and qualities may comingle as a result.

Figure 18. Helicopter delivering fire retardant.

Figure 19. Temporary water storage devise.

Figure 20. Pumping water from creek to tank.

For a variety of reasons, chemical fire retardant use on wildland fires has increased greatly in recent years. During the epic 2008 fire season, for example, nearly 23 million gallons of long-term retardant and water enhancers were utilized across the United States, including more than 13 million gallons in California alone.

Long-term retardants are most frequently delivered by fixed-wing aircraft and Type 1 helicopters (Figure 21). Comprised mainly of fertilizer salts (e.g., monoammonium phosphate, diammonium phosphate,

ammonium sulfate), as well as corrosion inhibitors, thickening agents and colorants, long-term retardants are mixed with water and applied to vegetation at strategic points ahead of the fire. Fertilizer salts, which adhere to the vegetation and remain long after the water has evaporated, act to prevent combustion or reduce fire intensity such that other suppression methods can work more effectively. Generally speaking, the heavier the fuels, the heavier the application of long-term retardant needed to achieve desired results.

Although clear formulations are available, fire managers prefer long-term retardants with colorants in order to more easily identify places on the landscape to which it has been applied. Colorized retardants come in two types—red (colored with iron oxide) and fugitive—the second of which also contains dye, but fades with exposure to sunlight.

Figure 21. Long-term retardants are delivered by helicopter or fixed wing aircraft.

Class A foams are liquid concentrates containing foaming and wetting agents that are mixed with water and applied to fuels with backpack and handheld pumps, hoses, and by air (Figure 22). Foaming agents affect how the product clings to surfaces and how quickly water drains away from the mixure, while wetting agents increase the ability of the draining water to penetrate fuels. Adding low amounts of concentrate to water produces "wet" foams that have little expansion, drain quickly, and penetrate fuels well; these are useful for horizontal applications (e.g., control lines). Higher amounts of concentrate produces "dry" foams that are viscous and drain very slowly; these cling tenaciously to vertical surfaces and are frequently employed to protect structures and other resources. Ingredients of foams are dominated by organic solvents such as fatty and higher alcohols commonly employed in detergents and cosmetics. Regardless of the composition, foams are only effective so long as water remains in the concentration. Thus, it is better than water, but does not provide the temporal benefits of long-term retardants.

Water enhancers are elastomeric polymers and copolymers that improve the ability of water to cling to vertical and horizontal surfaces. When mixed with water these "gels" are applied in manners similar to foams, but have the advantage of providing viable protection for a much longer time due to super-absorptive properties (very similar to disposable diapers). Water/gel mix ratios range from 0.1-1.2% (by weight); backpack pumps utilize the lowest concentrations, engines are intermediate, and aircraft the highest. Gels are commonly employed for structure protection, but are increasingly used on wildland fuels in roles usually reserved for long-term retardants (e.g., creating or augmenting control lines). One of the reported advantages of aerially applied gels is that water droplet size is increased, which reduces the negative effects of drift. In the interest of reducing aesthetic impacts most gels are clear, but one product with a fugitive colorant has been approved for use on federal lands.

Although the environmental effects of chemical fire retardants have received a great deal of publicity in recent years and valid concerns remain (see below), it is also true that efforts have been made to reduce the toxicity of formulations. For example, sodium ferrocyanide, dichromates, thiourea and polychlorinated biphenols (PCBs), ingredients used in earlier retardants, are now banned.

Work Areas: Staging, Aviation, Camps, Incident Bases, etc.

A great many operational activities are carried out in areas peripheral to and even far removed from the perimeters of wildland fires. Although perhaps less obvious than direct fire management actions like line construction and applying fire retardants, the presence of these areas and the activities performed within them can have implications for the well-being of natural and cultural resources. Some common examples are described below.

Vehicles, crews and supplies are frequently staged in proximity to wildfires. Technically, staging areas are places close to fires where resources are placed while awaiting tactical assignments. Ground resources like hand crews often require ground transportation and those vehicles need to be parked. In some cases, facilities exist, while in others parking areas may be created by simply pulling off-road or creating adequate spots (Figure 23). Other vehicles such as fuel trucks and water tenders are sometimes placed in staging areas to provide support for crews, engines and heavy equipment (Figure 24).

Aviation is critical to many fire management operations. As noted, both fixed wing aircraft and helicopters may be used for retardant drops. Other common tasks, for helicopters in particular, include reconnaissance, and transportation of personnel and supplies. On small and initial response incidents, most air traffic is conducted from established helibases (e.g., located at nearby airports or on parks or forests). During larger fires, a helibase may be established specifically for the incident, usually in large, open areas such as big parking lots and fields. Helibases can be very busy places during large incidents,

Figure 22. Applying foam and water from backpack pumps.

Figure 23. Off road parking area.

with multiple aircraft flying to and from the fire, and vehicular traffic in the form of personnel transports, and supply and fuel trucks (Figure 25).

On the fire, helicopters provide support ground resources at drop points and helispots. Drop points are locations suitable for delivering supplies and equipment using a long-line and/or landing (Figure 26). Helispots are temporary landing areas where personnel, supplies and equipment are loaded and off-loaded. For reasons of safety, there are strict standards for helispots; the landing area must be flat, free of vegetation, and of minimum area to accommodate the size(s) of helicopters that will be using it (e.g., 30 x 30 feet for Type 1, 15 x 15 feet for Type 3), the landing area is encompassed by a safety circle (level area free of trees, large brush, utility poles, etc.) of appropriate minimum diameter (e.g., 110 feet for Type 1, 75 feet for Type 3), and surrounding approach-departure path or paths that do not preclude safe approaches and departures (ideal is minimum of 300 feet free of potential obstructions). High points like ridgelines and low areas such as bottomlands are preferred landforms on which to establish helispots.

Fire managers prefer to utilize helispots that already meet the above criteria, whether natural or previously altered. In some cases, however, construction is required, such as felling of standing trees and snags, removal of understory vegetation, and minor leveling and removal of obstructions ,like rocks from the touchdown pad . Such work is usually performed with hand tools like chainsaws and digging and grubbing implements. In extreme cases, mechanized equipment like bulldozers may be employed in construction.

For helispots that are used frequently during an incident, dust abatement is an important issue. Water is preferred, but in cases where it is scarce, lignin sulfate is recommended. A byproduct of the lumber milling industry, lignin sulfate is an organic polymer commonly used to mitigate dust on unpaved roads.

Figure 24 Staging area.

Figure 25. Helibase

Figure 26. Helicopter supply delivery using a long line.
(NPS photo)

Figure 27. Helispot

Wildfires that last more than a couple of days and are staffed with firefighters may warrant the establishment of camps and/or standalone incident bases. Variables such as the number and types of personnel and resources assigned, location of the fire, current and projected fire behavior and spread, and management objectives will dictate the nature and location of the camp established. “Coyote” camps are created by self-sufficient personnel that remain on the fire for one or more operational periods and progressively move as conditions dictate. Such camps are typically informal affairs, with personnel spread out along or loosely congregated near the perimeter of the fire, and no one location is occupied for long (Figure 28). When coyote tactics extend for multiple operational periods, logistical support, provided by air and/or ground, is often necessary.

Longer-term incident management may be accomplished by establishing spike camps near the fire. Spike camps are established in safe locations that provide both good access to the fire and logistical support. In front-country areas, spike camps may be established in developed areas like existing campgrounds or parks. In remote wildland settings, spike camps may be placed in existing backcountry camps or undeveloped locations that fulfill the necessary requirements. As with helispots, fire managers prefer to select spike camps that are suitable with little or no modifications; “good campsites are found, not made” is a frequently cited philosophy. In cases where spike camps will be occupied by a large number of people and/or for a long period of time, spike camp layout may be highly regimented, with areas designated for sleeping, cooking and eating, food storage, latrines, gray water disposal, etc. (Figure 29). A spike camp manager may be assigned to a given camp, and he or she is responsible for day-to-day administration of activities.

Figure 28. Coyote camp.

Very large incidents will involve hundreds and perhaps more than a thousand personnel and many other resources. These always entail the creation of a standalone incident base where primary logistical functions are coordinated and administered. Among the components of an incident base may include the incident command post or ICP (where command functions are executed by the Incident Management Team [IMT]), main camp (fully equipped and staffed to support incident personnel), and helibase (Figure 30). Most parks have difficulties accommodating the spatial and logistical requirements of large incident bases. As a consequence, bases are usually established at nearby facilities, such as campgrounds, schools and farms or ranches (Figure 31). When fully operational, incident bases are busy places marked by the constant whine of generators and incessant vehicular and air traffic.

Mop-Up

Mop-up is the process of extinguishing, removing and securing burning materials located near control lines with the intent of preventing fire from crossing those lines. It is generally performed once fire spread has stopped or diminished and control lines completed. It is frequently the case that portions of the fire perimeter are amenable to mop-up even while fire burns actively in other areas.

Figure 29. Spike camp.

Figure 30. The Incident Command Base is located some distance from the fire.

Figure 31. Fire base camp

Mop-up will generally begin on any given portion of control line as soon as it is safe to do so. Efforts are focused on burning and smoldering materials, especially those with potential to directly or indirectly compromise the control line by rolling, falling or lofting embers. Smoldering roots located very close to the control line can also be problematic if they extend across the line. Any fuels deemed to be problematic will be mitigated; for example, heavy fuel concentrations are dispersed and/or burned, snags are dropped, burning and smoldering materials are extinguished with dirt and/or water, and potentially mobile materials on slopes are secured (Figure 32).

The amount of area mopped-up is a function of the fuels, projected and potential fire behavior, topography and other considerations. Generally speaking, the heavier the fuels, the more important mop-up becomes. Thus, in forested areas, mop-up may be conducted on much of the burned area on small fires, and up to several hundred feet inside of control lines of larger fires. In grass and light shrub fuels, where active fire consumed most of the fuels and residual smoldering is minimal, mop-up may not be necessary.

On fires requiring extensive mop-up, the amount of ground disturbance—both lateral and vertical—can be extreme. Still, like many aspects of fire management, the philosophy of mop-up has evolved from one of fully extinguishing every smoke to focusing on only those areas that pose a threat. For example, using a technique called cold-trailing, firefighters will seek out hot spots by hand and other means, and address only those deemed problematic. Technology has also benefited the process of mop-up in the form of hand-held or aircraft mounted forward-looking infrared (FLIR) devices that detect areas of differential heating within the burned area. FLIR data allow firefighters to focus their mop-up efforts in the hottest areas.

Figure 32. Extinguishing smoldering fires with water after a wildfire.

Suppression Damage Repair

As an incident begins to wind down and mop-up begins in earnest, fire managers turn their thoughts to suppression damage repair. Also commonly called fire rehabilitation or rehab, suppression damage repair, as the name implies, involves fixing impacts to lands, facilities and resources resulting from fire management activities conducted during the course of incident management.

Responsibility for performing suppression damage repair lies with the Incident Commander (IC) on a given fire. Ideally, the home unit(s) on which the fire occurred will provide the IC with a list of repairs to be performed and specifications for each. In the absence of such guidance, most ICs are versed in standard suppression damage repairs, such as litter removal, restoration of firelines, safety zones, helispots, camps, and other disturbed areas to “natural” condition, and repair of damages to facilities like roads and fences.

It is important to recognize that opinions may differ greatly among ICs and agencies with respect to the minimum repair standards for given impacts. Generally speaking, however, fire managers from federal agencies tend to be inclusive and open-minded, and recognize that repairs should be sufficient to mitigate the full range of potential effects from management actions. For example, commonly employed guidelines for restoring firelines on federal lands aim to incorporate and balance objectives related to soil stabilization, public use, invasive species, aesthetics, and other values.

By contrast, state and local agencies, which have direction protection authority for many park units in the PWR, have a much narrower view of what constitutes adequate damage repair. For example, dozer line repair standards for State and County firefighting agencies in California involve periodically constructing water bars perpendicular to slopes (often in the course of building the line) to reduce overland runoff down the line (Figure 33).

Figure 33. Water bars in place.

Minimum Impact Suppression Tactics (MIST)

Minimum Impact Suppression Tactics (MIST) are strategies and tactics that safely and effectively meet both fire management and resource objectives with the least environmental and social impacts. For example, a fireline is constructed with the intent of halting fire spread, and the nature of that fireline (e.g., width, construction methods) should be dictated by the prevailing and projected conditions. Using only the width necessary to accomplish that objective is both good fire management and environmentally desirable.

The notion of MIST has become entrenched in the lexicon of wildland fire management as firefighting diverges away from a "suppression at all costs" mentality towards one more in tune with overall land, resource and incident management objectives. Indeed, the NWCG issued guidance advocating the adoption of MIST, and NPS policy direction is to employ MIST for all fire management activities on NPS lands.

The best MIST guidelines will include a combination of very general direction (e.g., construct firelines no wider than necessary to prevent fire spread, remove all trash, minimize ground disturbance in archeological sites) and unit-specific data (e.g, maps of existing firefighting infrastructure such as control lines and helispots, maps of sensitive resources).

While the acceptance of MIST in wildland firefighting has grown, there remain many misconceptions among fire and resource managers about the specifics of minimum impacts techniques. Several of these are summarized below:

1. **MIST compromise safety:** Some feel that minimum impact techniques create less safe conditions on the fireline. It can be stated unequivocally, however, that unsafe strategies and tactics are not MIST. By way of example, snags along control lines and other operational areas constitute a threat to fire management personnel and others and snags are routinely felled to mitigate those risks. Many MIST guidelines, however, contain language calling for the retention of snags to preserve wildlife habitat. Not felling hazard trees in close proximity to firefighting resources would not be MIST; snags might be retained, but are an unacceptable risk for firefighters. Rather, MIST would involve measures to place firefighting infrastructure in areas where potential hazard trees were absent or found in lesser numbers; snags would be retained by virtue of not having to drop them, and firefighters encounter safer conditions by not having to work near snags (not to mention the safety issues associated with felling hazard trees).
2. **MIST reduce effectiveness:** It is believed by some that MIST are inherently less effective at accomplishing incident objectives than "non-MIST". This is not the case; MIST are intended to both accomplish incident objectives <u>and</u> reduce undesirable impacts. Thus, constructing a four foot-wide fireline in a situation where an eight foot width is needed to stop fire spread is not MIST. MIST in this context might involve constructing fireline in lighter fuels so that narrower fireline will prove effective or perhaps identifying natural barriers that can be incorporated into the fireline as a means of reducing the amount of wide fireline constructed.
3. **MIST mean less:** Some suggest that MIST are inherently "lighter-handed" than non-MIST; for example, hand tools are MIST, but mechanized equipment are not. MIST, however, are not a laundry list of acceptable strategies and techniques that will not exceed preconceived impact thresholds, but rather flexible, contextually-derived approaches that conform to the realities of time and place. For example, in a bow to extreme fire behavior and an expansive WUI, bulldozers are a common piece of equipment on many wildfires in southern California. This does not mean, however, that those incidents with bulldozers are outside the parameters of MIST. Instead, dozers are sometimes directed to construct firelines on acceptable landforms that have already experienced such disturbances, or along existing road corridors. Thus, while the damage done can still be substantial, it occurs in previously disturbed areas rather than creating new ones.